Analytical Studies Branch

TESTING THE ROBUSTNESS OF ENTRY BARRIERS

by

J. R. Baldwin and M. Rafiquzzaman

No. 51

Research Paper Series

Statistics Canada   Statistique Canada

Canada

ANALYTICAL STUDIES BRANCH
RESEARCH PAPER SERIES

The Analytical Studies Branch Research Paper Series provides for the circulation, on a pre-publication basis, of research conducted by Branch staff, visiting Fellows and academic associates. The Research Paper Series is intended to stimulate discussion on a variety of topics including labour, business firm dynamics, pensions, agriculture, mortality, language, immigration, statistical computing and simulation. Readers of the series are encouraged to contact the authors with comments, criticisms and suggestions. A list of titles appears inside the back cover of this paper.

Papers in the series are distributed to Statistics Canada Regional Offices, provincial statistical focal points, research institutes, and specialty libraries. Each paper is catalogued on the DOBIS computer reference system and in various Canadian university library reference systems.

To obtain a collection of abstracts of the papers in the series and/or copies of individual papers (in French or English), please contact:

Publications Review Committee
Analytical Studies Branch, Statistics Canada
24th Floor, R.H. Coats Building
Ottawa, Ontario, K1A 0T6
(613) 951-8213

TESTING THE ROBUSTNESS OF ENTRY BARRIERS

by

J. R. Baldwin and M. Rafiquzzaman

No. 51

Business and Labour Market Analysis Group
Analytical Studies Branch
Statistics Canada
1993

Aussi disponible en français

TESTING THE ROBUSTNESS OF ENTRY BARRIERS

by

J. R. Baldwin
M. Rafiquzzaman
Business and Labour Market Analysis Group
Analytical Studies Division
Statistics Canada

Abstract: Longitudinal panel data from the Canadian Manufacturing sector are used to model the entry process and to investigate the existence of entry barriers. The paper investigates the robustness of previous findings by 1) using a variety of estimation procedures 2) testing different model specifications 3) varying the measures used to evaluate the importance of entry.

Key Words: entry models, firm populations, negative binomial estimation, count data estimation

1. **INTRODUCTION**

Conventional price theory predicts that under perfect competition positive economic profit will be transitory. Positive economic profit results in entry. The process of entry of firms will continue until each firm earns zero economic profit. With this theoretical framework, it is precisely excess economic profit that attracts new entry.

The field of industrial organization has modified the conventional micro-economic view by stressing that adjustments to this disequilibrium phenomenon are, however, not smooth and that the path of adjustment in turn affects the level of profits in different industries. Certain factors such as advertising, research and development and concentration have been posited to act as entry barriers and to perpetuate profit differences across industries.

Since the seminal works of Bain (1956) and Modigliani (1958), the economic profession's attention has focused on the existence of entry barriers. Empirical work on entry has generally taken the disequilibrium view of entry that profits attract entry . The most widely-used models are the "Limit-Price" models of entry in which it is argued that the profit levels above which entry is attracted differ industry by industry and are a function of entry barriers. Incumbents can set higher prices in industries with high barriers without attracting entry. The level of price above which entry occurs is the limit-price. Determinants of entry and their implications for market structure and performance have

traditionally been estimated by employing Orr-type (Orr, 1974) models.[1] Implicit in the "Limit-Price" model is the view that an entrant augments existing output. Alternately, the "Stochastic-Replacement" view of entry is based on the assumption that entry is a dynamic process involving both partial and complete replacement of existing firms by entrants (Baldwin and Gorecki (1983), Shapiro and Khemani (1987)). The "Replacement" view of entry presumes that entry can be expected even when price equals long-run average cost and industry profits are zero.

There are at least two reasons to expect entry even when industry profits are zero. First, to the extent that cost heterogeneity exists within an industry, low-cost firms can expect to enter and earn positive profit even if the industry reports zero economic profits as a whole. That is, some potential entrants who have cost advantages over some high-cost incumbents will enter and replace the high-cost incumbents. Secondly, a potential entrant can profitably enter if it expects to produce a superior product. In such a case, entrants with high quality products will replace incumbents who produce low quality products, even though both entrants and incumbents have identical costs.

Limit-price entry models purport to confirm the existence of entry barriers and, therefore, the existence of market imperfections.[2] The models that combine the stochastic-replacement phenomenon with the limit-price model, however, find that entry barriers are much less important (Baldwin and Gorecki, 1987).

As is often the case in applied economics, interpretation of

the significance of these differences is complicated by the fact that previous studies differ not only in terms of choice of model but also in terms of how entry is measured--units of observation, units of measurement, type of entrants, and time period.

Entry studies differ substantially in terms of how entry has been measured. Some have measured entry in gross terms; others have measured entry net of exit. Some have measured entry using new plants; others have used new firms. Some have used number of entrants; others have used shipments of entrants. Some have measured entry over short time periods; others have measured the cumulative effect of entry over longer periods. Generalizations about the determinants of the entry process are difficult to make when the measurement of entry in different studies varies so widely.

This paper investigates the extent to which the findings of the importance of entry barriers depends on the measurement of entry. It does so by investigating the extent to which estimation techniques, model specification, and measurement alter the conclusion that entry is detrimentally affected by certain industry structural characteristics.

The paper focuses on a specific form of entry--greenfield entry by new firms. This involves the entry of a firm by plant construction. In order to test the robustness of the entry model to variation in measurement, two separate dimensions are allowed to vary--the time-period and the units used for measurement. On the one hand, the importance of entry is measured both in the short and

the long run. On the other hand, entry is measured using number of entrants, shipments of entrants, the average size of entrants, and the survival rate of entrants.

The paper also examines whether the estimated effect of entry barriers is sensitive to the regression procedure used. Prior empirical studies of entry [with the notable exception of Chappell, et. al (1990), Mayer and Chappell (1992) and Papke (1991)] have employed classical regression models of entry, and the principle of ordinary least squares has been the method of model estimation. However, entry data are non-negative integer-valued random count data and deviate from classical regression assumptions. Statistical estimation is more appropriately done with a discrete probability distribution. As a consequence, the Poisson and Negative Binomial distributions were used to estimate entry as a non-negative random count. The results of the Poisson and the Negative Binomial regressions are compared and contrasted with those derived from the classical OLS regression model.

The paper is organized as follows. Section 2 contains a discussion of the issues relevant to the measurement of entry. Section 3 describes the model that is estimated and the explanatory variables that are used. Section 4 presents both traditional and count data models of entry and discusses their estimation procedures. Section 5 compares the results across different time periods and across different units of measure. The paper ends with conclusions in section 6.

2. THE MEASUREMENT OF ENTRY

Entry can be defined as the birth of a producing unit--a new plant or a new firm. In the first case, entry is defined as a new plant in a particular industry. In the second case, it is defined as a new firm with a new producing unit--a greenfield entrant. Entry can also be defined as the birth of a new legal entity. New legal entities may be associated with the birth of new plants; but they also include firms which enter an industry by acquiring existing firms. Entry can be defined either in gross or in net terms. In the former case, it is the total number of plants (firms) entering an industry in a given period. In the latter case, it is the difference between the number of plants (firms) in two different periods.

This paper uses a definition of entry implicit in the limit-price entry literature--greenfield entrants. This is a relatively homogeneous category. The definition uses greenfield entrants rather than both greenfield and merger entrants, since the latter do not, initially at least, augment industry output. It focuses on gross measures rather than net entry measures which combine the effect of both entry and exit. It measures entry as new firms that build new plants and not new plants per se. The latter include both greenfield entrants and also plants that are built by incumbent firms. Failure to distinguish between new firms and existing firm new plant activity confuses entry with the expansion decisions of continuing firms. Evidence (Baldwin and Gorecki, 1983, 1987) shows

substantial dissimilarities in the determinants of greenfield and merger entrants, of greenfield entrants and the plant creation process by continuing firms, of gross and net entry measures.

The importance of greenfield entrants is measured in this paper both in terms of their number and their size. The strength of the competitive forces associated with entry probably depends both on the number of entrants and the share of a market that is captured by the entrants. If the two measures were highly collinear, there would be little need to worry about whether structural barriers affect the two measures differentially.

The percentage of shipments in a market captured by entrants is equal to the count rate of entry times the average size of entrants relative to the population. However, high rates of entry using count data may be negatively correlated with the relative average size of entrants and, therefore, count-based rates and shipment-based rates may not be closely related. In this case, industries with a large number of entrants may not be those where entrants capture a large share of the market. In order to test the robustness of our results, we used all three--count of entrants, the shipments of entrants, and the average size of entrants--as dependent variables in the regression analysis.

The importance of entry to the competitive process and market performance is also evaluated by using both short- and long-run data. Short-run estimates are derived by using two adjacent points of time; long-run estimates, by using two points removed from one another in time. Generally entrants are small at birth and many

entrants do not survive for many years. Moreover, the rate at which short-run performance translates into long-run market share may vary across industries. Therefore, short and long-run measures of entry were investigated separately.

Short and long-run entry were estimated at the 4-digit SIC level for the Canadian manufacturing sector using a longitudinal data base that followed firms and plants between 1970 and 1979. A description of the file can be found in Baldwin and Gorecki (1990). Short-run rates of entry were estimated for each year between 1970 and 1979 and averaged. Long-run rates of entry were calculated as the number of firms in 1979 that had entered the industry since 1970. It is the total entry of all firms in each year since 1970 minus the deaths of entrants over this period.

The importance of entry to the competitive process and market performance is also evaluated in this paper with a fourth measure which captures the extent to which entrants do not quickly die. This measure is calculated as the long-run entry count divided by the sum of the short-run entry count. This is the proportion of all entrants over a decade that are still alive at the end of the period and is a direct measure of population continuance or an inverse measure of infant mortality.

3. MODELS OF ENTRY

The most common entry models follow the earlier work of Orr(1974), which posits that entry will occur whenever profits are

above their entry-precluding levels. Following Orr, the model of entry is

$$E_{it}=f(P_{it}-P^{*}_{it}),\ldots(1)$$

where E_{it} is the entry into industry i at time t, P_{it} is the entrant's perceived post-entry profit and P^{*}_{it} is the entry-precluding profit in industry i at time t.

The entry-precluding profit, P^{*}_{it}, depends on a vector of entry barriers, B, and a market risk variable, R. P^{*} (ignoring time and industry subscripts) can be specified as $P^{*} = h(B,R)$. As a consequence, the entry model in (1) may be written as

$$E=f_{1}(P,B,R)\ldots.(2)$$

E is expected directly to vary with perceived post-entry profit, P, and negatively with every component of B and R. It is, therefore, hypothesized that profit induces entry, whereas barriers to entry and risk reduce entry.

In our estimation, expected profitability (P_{it}) is represented by two variables. The first (PR) captures the average profitability that small firms might expect to make in an industry over the period. It is represented by average industry profitability interacted with the difference between this average and small firm profitability since entrants are generally small and small firms often earn less than large firms. Since the average does not incorporate information about the trend that might be expected to

influence expectations about future profits, the growth in profits (GP) over the period is also included. Entry is expected to be greater in those markets where profits are growing.

Barrier variables (B) are represented by economies of scale (MES), concentration (CON), advertising intensity (AD), and research and development intensity (RD). Market risk (R) is represented by volatility of market growth (VMG).

Equation #2 is an incomplete specification of entry since it does not consider stochastic aspects of entry. According to the "stochastic-replacement" view, a substantial amount of entry simply replaces existing firms, and occurs even if economic profits are zero. This flow of entry by replacement is posited to depend upon the size of the market. When firm counts are used to measure entry, size of the market (S) is taken to be the number of firms in the industry (N). When shipments of entrants is used as the dependent variable, size of the market is measured in terms of total industry shipments (TVS). The effect of the market-size variable can be interacted with the barrier variables to determine whether the magnitude of stochastic replacement is affected by the barrier variables.

The amount of entry should also depend on how easily entrants can enter and capture part of the market. This is related to whether, in the post-entry period, products of new firms will be consumed by consumers. A market with rapid growth will be associated with new consumers and, therefore, there is a greater likelihood that new firms will be gaining market share. Positive

growth in demand makes entry easier because the price level is less likely to fall after entry occurs. Existing firms may not respond adversely to the additional sales made by the entrants when their own sales are growing. In order to capture this part of the stochastic process, industry growth, G, is added to equation #2. Following Baldwin and Gorecki (1983, 1987) an entry model which incorporates both stochastic-replacement and limit-price views of entry is specified as

$$E=g(S,G,P,B,R) \ldots (3)$$

S, G, and P provide incentives to entry, whereas B and R provide disincentives.

4. <u>ESTIMATION PROCEDURES APPROPRIATE TO COUNT DATA</u>

Many previous empirical studies of entry have estimated a linear and/or a loglinear version of the entry equation(3), or something close to it, and the OLS method of estimation has mainly been used. Since entry data are integer-valued and deviate from classical regression assumptions, the statistical specification of entry calls for a discrete probability distribution. In order to meet this requirement, we specify and estimate an econometric model of entry based first, on the assumption that each observation is drawn from a Poisson distribution, and then, from a Negative Binomial distribution. Our methodology is in the spirit of Hausman, Hall and Griliches (1984), and Cameron and Trivedi (1986), who apply both the Poisson and Negative Binomial regression to count

data on firms' patenting activity and consumer demand for health care services, respectively. It is also in the spirit of Chappell, et. al. (1990), Mayer and Chappell (1992), and Papke (1991) who use Poisson regressions to study the entry behaviour of firms across industries in the U.S.

The use of the discrete distribution is inherently more satisfactory than classical OLS procedures on a priori grounds; it also makes two additional contributions to the analysis of entry. First, many previous studies have employed Orr-type models and have used gross or net entry as the dependent variable. Loglinear versions of the entry equation have been estimated. The logarithm of entry is, however, defined only for those industries showing positive entry; it is undefined when entry is absent. Relevant information contained in the data set are lost. Use of the theoretical discrete distribution for integer counts surmounts this problem.

A second limitation of the log specification of entry is that the estimation of parameters by ML principle assuming a normal distribution is inappropriate. When entry is a discrete dependent variable, the error term in the log of entry equation cannot be normally distributed. However, when entry is specified as Poisson or Negative Binomial, ML estimates of parameters are readily available.

For notational convenience, we specify the entry equation(3) as

$$E_i = g(X_i), i = 1,2,...,n, \ldots (4)$$

where $X_i = (S_i, G_i, P_i, B_i, R_i)$. E_i denotes the number counts of new entrants in industry i and S_i, G_i, P_i, B_i, and R_i are the explanatory variables discussed in section 4. Under the assumption that the data on entry are drawn from a Poisson distribution, the probability of observing a count of entry E_i in industry i is

$$Pr(E_i) = Exp(-\lambda_i) \lambda_i^{E_i} / E_i!, E_i = 0,1,2,\ldots, \ldots (5)$$

The mean and variance of E_i are equal to λ_i. To incorporate exogenous variables, X_i which influence entry, including a constant, the parameter λ_i is specified to be

$$\lambda_i = E(E_i|X_i) = Exp(X_i\beta), \ldots (6)$$

where β is a parameter vector to be estimated. The Poisson parameter, λ_i is a function of X_i and an unknown parameter vector, β. The Poisson model is analogous to the familiar classical regression model in the sense that $E(E_i|X_i) = \psi(X_i,\beta)$, where $\lambda_i = \psi(X_i,\beta)$. To obtain the ML estimate of β, β is chosen to maximize the log likelihood of the sample of n industries:

$$L(\beta) = \sum_{i=1}^{n} [-\log E_i! - Exp(X_i\beta) + E_i X_i \beta] \ldots (7)$$

There is, however, one important restriction in the Poisson regression model which limits its application. The Poisson has a conditional mean and variance of E_i given X_i that are equal. Many integer data sets do not satisfy this assumption. They are said to possess overdispersion when the variance is larger than the mean.

If data show overdispersion, and the restriction of equality of mean and variance is imposed, estimates of the standard errors of β will be unduly small.

As suggested by Gourieroux, Montfort and Trognon (1984a,b), one way to incorporate overdispersion in the Poisson model is to replace (6) by the stochastic equation

$$\ln\lambda_i = X_i\beta + \varepsilon_i, \ldots (8)$$

where ε_i is the error term. Let $z(\varepsilon_i)$ denote the probability density function for ε_i. Then the joint density function of E_i and ε_i is written as

$$\Pr(E_i, \varepsilon_i) = [\mathrm{Exp}(-\lambda_i)\lambda_i^{E_i}/E_i!]\, z(\varepsilon_i), \cdots (9)$$

where $\lambda_i = \mathrm{Exp}(X_i\beta + \varepsilon_i)$. Then the marginal density of E_i can be obtained by integrating (9) with respect to ε_i:

$$\Pr(E_i) = \int [\mathrm{Exp}(-\lambda_i)\lambda_i^{E_i}/E_i!]\, z(\varepsilon_i)\, d\varepsilon_i . \ldots (10)$$

Expression (10) defines a compound Poisson distribution whose precise form depends upon the specific choice of $z(\varepsilon_i)$. If $z(\varepsilon_i)$ has a Gamma distribution, or equivalently, λ_i is assumed to follow a Gamma distribution with parameters ϕ_i and ν_i [$\phi_i>0$, $\nu_i>0$; ϕ_i is the mean and ν_i is called the index or precision parameter of gamma distribution], then Cameron and Trivedi (1986) show that the expression (10) reduces to a family of negative binomial distribution with mean and variance

Since $\phi_i > 0$ and $\nu_i > 0$, it is clear that the variance exceeds

$$E(E_i) = \phi_i \ldots (11)$$

$$Var(E_i) = \phi_i + \phi_i^2/\nu_i \ldots (12)$$

the mean and there is overdispersion . Substituting $\phi_i = Exp(X_i\beta)$ and $\nu_i = 1/\alpha$, $\alpha > 0$, into expressions (11) and (12), a specific form of the Negative Binomial distribution is obtained such that

$$E(E_i) = Exp(X_i\beta) \ldots (13)$$

$$Var(E_i) = E(E_i)[1 + \alpha E(E_i)] \ldots (14)$$

This will be the version employed in this paper.

5. RESULTS

The empirical results are presented in three parts. The first uses a traditional entry equation for the number of entrants which incorporates both the limit-price and stochastic-replacement views of entry. It compares the results of OLS estimation to estimation of the Poisson and the Negative Binomial to show the improvements that are made by using the estimation procedure that recognizes that entry is measured using integer-count data. The next section investigates the extent to which the effect of entry-barrier variables on the number of entrants is robust to whether the limit-price as opposed to the stochastic-replacement model is used. The final section compares the effect of entry-barrier variables for alternative measures of entry by using four different dependent variables--number of entrants, shipments of entrants, average size

of entrants, and population continuance rates of entrants.

A) The Effect of Alternative Estimation Procedures

For comparison purposes, count data of entry were estimated with the number of greenfield entrants (E) as the dependent variable using a straightforward combination of the limit-price entry and the stochastic-replacement model. The implicit equation in linear form from the Poisson was:

$$\log(E) = a_0 + a_1 * CON + a_2 * MES + a_3 * AD + a_4 * RD + a_5 * PR + a_6 * GP + a_7 * GS + a_7 * VMG + a_8 * N...$$

The first estimate used OLS, the second was a count model using a Poisson regression, and the third was a count model that used a Negative Binomial. The latter two were estimated by maximum likelihood procedures. Both long- and short-run data were used to examine whether the results depended on the time period chosen to measure entry.

The three models differ according to the parameterization of the conditional mean and variance. For the linear model, the mean is parameterized as $X\beta$, the variance as α. For the Poisson model both the mean and variance is $\mathrm{Exp}(X\beta)$. In the case of the Negative Binomial, the mean equals $\mathrm{Exp}(X\beta)$, while the variance is $\mathrm{Exp}(X\beta)[1 + \alpha\, \mathrm{Exp}(X\beta)]$.

The results are presented in Table 1. The levels of significance for rejecting the null hypothesis that the coefficients of the variables are zero and the estimated standard errors of the estimates are reported in parentheses and brackets,

respectively. Columns 1-3 represent the results for the long run, whereas columns 4-6 represent those for the short run.

In both the long and the short run, the estimated standard errors of the Poisson and Negative Binomial models are substantially lower than those of OLS estimates. These findings are consistent with those of Hausman, Hall and Griliches, and Cameron and Trivedi.

Although the Poisson point estimates and those in the Negative Binomial model are similar in sign and magnitude, the estimated standard errors under the Poisson model are substantially smaller. This essentially reflects the consequence of imposing the restriction that the conditional mean and variance of the Poisson distribution are equal.

In order to choose between the Poisson and Negative Binomial regressions, a test of the null hypothesis that the underlying model is Poisson with mean = variance = $\text{Exp}(X\beta)$ against the alternative that the model is a Negative Binomial with mean = $\text{Exp}(X\beta)$ and variance = $\text{Exp}(X\beta)\ [1 + \alpha\ \text{Exp}\ (X)]$ is required. Both the Wald test and the Likelihood Ratio test do this. The Wald statistic for testing the Poisson against the Negative Binomial is 8.65 and 8.54 for the long-run and the short-run, respectively. The corresponding Likelihood Ratio test statistics are, respectively, 848.20 and 15428.78. Both the Wald and Likelihood Ratio test statistics are highly significant. Furthermore, the overdispersion parameter, α, is significant. The data reject the equality of the mean and the variance which is the key property of the Poisson

model. The significance of the overdispersion parameter (α) and both tests lead to the strong rejection of the Poisson model in favour of the Negative Binomial. The results of the Negative Binomial regression will be used to compare the results of the count model to the OLS estimates.

The OLS procedure generates three significant variables in both the short and the long run. The entry process is positively related to the existing number of firms (N), the growth of shipments (GS) and risk, measured in terms of volatility of growth (VMG) [Table 1]. Other variables are not statistically significant.

Each of the variables that are significantly different from zero in the OLS estimate are also significant and have the same sign in the Negative Binomial regression. In addition, the Negative Binomial has a significant and negative coefficient for two entry-barrier variables in both the short and the long run that were not significant in the OLS equation. These are plant scale economies (MES) and concentration (CON). Research and development has a positive affect on entry in both the long and the short run but is only significant in the short run. Advertising is not significant either in the OLS or the Negative Binomial model.

The predictive power of the OLS and the Negative Binomial models are compared in Tables 2 and 3. Table 2 presents the mean value of predicted entry and the mean value of observed entry using each of these estimating techniques and the model used for the long-run entry values presented in Table 1. The standard error of the residuals is also described. The Negative Binomial overpredicts

observed entry relative to the OLS and has a standard deviation that is larger. On the other hand, it does not produce predictions of negative entry as does the OLS method. The relative predictive power over the range of observations is presented in Table 3. For small entry counts, the Negative Binomial has a smaller range of estimates: for the larger values of entry counts, the Negative Binomial has a wider range of values. It is in the smallest size class--entry counts of 0 to 5--that the OLS predicts negative values. The Negative Binomial does not have this problem.

In conclusion, choice of the Negative Binomial over the OLS overcomes earlier observations that entry barriers are positive but insignificant determinants of the entry process. The choice of the integer-count model substantially increases the significance of the effect of concentration and plant scale economies variables.

B) The Limit-Price and the Stochastic-Replacement Models for Count Data

The effect of the estimation procedure was investigated in the previous section with an amalgam of the limit-price and the stochastic-replacement views of the entry process. In this section, we adopt the negative binomial regression technique and examine the robustness of our conclusions about the effect of entry barriers to changes in the specification of the entry model. Once more, we measure entry by the number of greenfield entrants in both the short and long run.

Three different models were estimated for the both the long- and the short-run entry count data. The first equation used just the variables that originate from a simple Orr-type model. These are profitability (PR), growth in profitability (GP), growth in sales (GS), concentration (CON), economies of scale (MES), research and development (R&D), advertising intensity (AD), and demand variability (VMG). The second formulation added the industry size variable--number of firms (N) to the first. The third formulation added an interaction term involving industry size and the entry-barrier variables--concentration (CON), advertising intensity (AD), research and development intensity (R&D), and economies of plant scale (MES).

The results are reported in Table 4. Columns 1-3 present the results for the long-run, whereas columns 4-6 present those for the short run. The significance levels of a two-tailed test for rejecting the null hypothesis that the co-efficient is zero are given in parentheses. The associated standard errors of the estimates are reported in brackets. In the following discussion, a variable is considered to be significant if the level of significance is 5 percent or less.

The barrier variables that are significant in the simple limit-price model (cols. 1 and 4) are also significant in the two models that incorporate the stochastic-replacement phenomenon (columns 2 and 3; 5 and 6). Concentration (CON) and scale economies (MES) negatively affect entry in all formulations.

Nevertheless, the size of the coefficient on the concentration

variable decreases by about 50% when the stochastic-replacement model (columns 2 and 4) is used. Moreover, in the third variant (columns 3 and 5), the fact that scale economies has a positive coefficient when interacted with number of firms means that the effect of scale economies declines as the number of firms in the industry gets larger. Indeed for all industries where the number of firms (N) is greater that 30, scale economies will not have a negative impact on entry. If the same exercise were conducted with concentration, the break-even value is about 47 firms. Barriers matter--but not where firm numbers are relatively high.

It is also noteworthy that advertising is weakly significant when interacted with the size of an industry. The rate of stochastic-replacement is lower in industries with high advertising-sales ratios. This is in marked contrast to the first column where it was not found to have a significant impact when included as a proxy for an entry barrier that affected the level of limit entry profits.

In summary, we do not reject the observation that entry barriers exist when the model specification is varied. We do change our view of the extent to which they are important.

C) Alternative Measures of the Importance of Entry

In each of the two previous sections, entry is measured by the count of new firms. In this section, we examine whether the

determinants of entry remain the same when the unit of measurement that is used to define entry is changed. Four separate measures of entry are used to compare the robustness of our findings on the importance of entry barriers. Each of these is measured for both the long run and short run.

These are:

(1) the number counts of greenfield entrants (E),

(2) the amount of shipments by entrants (TVSE),

(3) the average size of entrants (ASE), and

(4) the ratio of the number of entrants in the long-run to the number of entrants in the short-run (RATIO).

Each dependent variable is regressed on the same set of explanatory variables, with one exception. The normalizing variable for the numbers count is the number of firms in the industry (N); for entry shipments (TVSE), it is total values of industry shipments (TVS); for the average size of entrants (ASE), it is the average size of existing firms (ASF); for the population continuation rate, RATIO, it is the average size of entrants relative to the industry average size (RELSIZE).

Table 5 presents the results for the long run; Table 6, the results for the short run. The significance levels of a two-tailed test for rejecting the null hypothesis that the co-efficient is zero are given in parentheses. The associated standard errors of the estimates are reported in brackets. Once more, a variable is considered to be significant if the level of significance is 5 percent or less.

The model was estimated using the Negative Binomial for the entry count measure and OLS for other variables.[3]

A comparison of the entry count data and the industry shipments equations reveal that the former has less explanatory power. A simple OLS of the counts data (not reported here) has a considerable higher adjusted R^2 than the OLS for shipments data--in the long-run results, .81 as opposed to .41 respectively. This is because the explanatory variables do a poor job of describing the average size of entrants. The adjusted R^2 for the equation using the average size of entrant in the long run as the dependent variable was only .32. Despite this difference, most of the significant coefficients in the count and shipments equations tell the same story. Entry depends positively on size, growth of shipments, and negatively on concentration.

While these variables tell basically the same story for the count and shipments data, they do not always affect the average size of an entrant (ASE) in the same way. Growth positively affects average size of the entrant (ASE) and the success rate (RATIO), but in neither case it is very significant. Growth thereby affects the importance of entrants because it affects the number of entrants and not because it facilitates entrants of a larger average size. Growth also positively affects the success rate (RATIO), but the coefficient is not significant.

Concentration also has a different effect on entry counts than on average size. Higher concentration leads to fewer entrants but it has a positive but insignificant effect on the average size of

an entrant. There are, therefore, fewer entrants in concentrated industries but the entrants tend to be bigger--probably because the cost disadvantages of small scale entry are greater in these industries. Concentration is also associated with a significant positive effect on RATIO--the success rate of entrants.

While profits--either PR or GP--are rarely significant, there is a difference in the sign associated with this variable in the counts and shipments equations. Profits are positively related to the number of entrants but negatively related to shipments. This occurs because higher profits allow more entrants to penetrate an industry, but these entrants are smaller.

Finally, it should be pointed out that industry variability has a significantly positive effect on numbers of entrants but not on average size. Variability perhaps leads to greater entry because highly cyclical industries require more entry for profit equilibration purposes. Industries that experience more cyclical swings do not experience entry at larger average size but they do have a higher success rate as measured by RATIO.

In conclusion, the entry-barrier variables that have been so often stressed in the literature are less important when we turn to measure the impact of entry in other than simple count terms. It may be that there are fewer entrants in concentrated industries, but the entrants in these industries tend to be larger and, therefore, concentration does not have as great an effect on shipments captured by entrants as it does on their numbers. Moreover, entrants in concentrated industries have greater staying

power. The number of entrants that survive is greater in concentrated industries.

D) Alternative Measures of the Profitability and Entry Barrier Variables.

This section examines the effect of using alternative measures of the explanatory variables in the regression analysis. Both profitability and entry barrier variables can be measured in more than one way.

In the first three sections, profitability has been measured as shipments minus materials and energy expenses minus wages and salaries divided by a measure of capital stock derived by the perpetual inventory method. The numerator comes from the Census of Manufactures and the denominator from a survey of investment. Alternately, the profitability of an industry can be derived from income and balance sheet data as profits divided by capital stock. Concentration has been measured by the market share of the top four firms (CR4). The economies of scale variable that was used proxied the minimum-efficient-sized plant by the share of output accounted for by the plants in the top half of the size distribution, which Davies (1980) has shown is just another measure of inequality. The structural characteristics that are associated with entry barriers can also be measured in a variety of other ways. Alternate measures for both concentration and scale economies were presented in Baldwin and Gorecki (1991).

In the case of the profit variable, no one measurement is inherently superior to another. On the one hand, using price-cost margins to measure profitability is imperfect because they contain a margin that includes payments for services and taxes. Other disadvantages of using price-cost margin data were discussed in Baldwin (1992). On the other hand, rates of return derived from balance sheet data do not perfectly measure the concept of internal rate of return either.

The same indeterminacy exists for measures of entry barriers due to concentration. A number of measures of concentration have been derived. None is inherently superior to all others because there are different dimensions to market structure that are not captured by any one measure.

In the face of the large number of alternate measures, it is inappropriate to draw conclusions about the importance of entry barriers without some experimentation with alternate measures. However, there are too many alternatives for the analysis to proceed by including each potential candidate in a sequential fashion. The solution adopted here is to reduce each group of variables to its principle components and to employ these components in the regression analysis--as in the analysis in Baldwin and Gorecki (1991) that investigated the relationship between mobility and concentration.

The concentration variables are those used in Baldwin and Gorecki (1991)--the herfindahl (HF), the four-firm concentration ratio (CR4), the marginal concentration ratio for firms ranked

numbers five to eight in an industry (MCR8), the size of the group of firms ranked from five to eight divided by the size of the top four firms (REL84), the variance of firm size (VARSH), the relative redundancy ratio (RELRED) and the relative numbers equivalent (RELNUM).[4] The principle components PCR1-PCR7 are presented in Table 7.

The same set of plant scale variables that were used in Baldwin and Gorecki (1991) are also employed. These include the economy of scale estimate derived from a production function (SCALE), the cost-disadvantage ratio (CDR--the ratio of the labour productivity of the smaller firms to the larger firms) and the Lyons estimate of minimum efficient scale (BMES--the size at which firms begin to build two plants rather than one).

The profitability variables include both those derived from balance sheet data and from the Census of Manufactures price-cost data. Balance sheet measures include both the return on equity and the total return on capital.[5] Several variants of each were employed. These include: the average rate of return on equity and on capital for the 1970s (PREQ7281 and PRCAP7281, respectively), the estimate of long-run equilibrium return on equity and on capital (LPEQ and LPCAP, respectively) derived in the spirit of Mueller (1986) from an autoregressive process for the period 1972 to 1986, and the speed with which profit returns to equilibrium for both return on equity and on total capital (BETAEQ and BETACAP, respectively).

Three measures of profitability based on profit residuals from

the Census were used. The first is the average profitability of continuing plants that is used in the previous section (PR). The second is a measure of the expected profitability of small plants (PRSMALL). This is defined as PR times the difference between the profitability of the largest firms in the industry and the smallest firms and captures what entering firms might expect if they base their expected profits not on average incumbent experience but on small firm experience. The third Census profit variable is the rate of growth in profitability (PR) between 1970 and 1979 (GP).

The principle components of the concentration variables are reported in Table 7 [see also Baldwin and Gorecki (1991)]. The first two components exhaust three-quarters of the total variance in the sample.

The principle components of the profit variables are presented in Table 8. The different profit measures are not highly collinear. The first component accounts for only some 29 percent of the total variance of the sample; the second for 23 percent, the third for 21 percent. The first gives greatest weight to the equity and the total capital rates of return for the period 1972 to 1981 (PREQ7281 and PRCAP7281). The second component primarily weights the Census profit variables. It weights both the average (PR) and the expected small firm performance (PRSMALL) equally. It varies inversely with both of these profit variables. Interestingly, the eighth component weights the same two variables but with opposite signs and varies directly with average profitability but inversely with small firm profitability. The third component varies directly with average

rates of return (PREQ7281 and PRCAP7281) and with the long-run estimated equilibrium rate of return on total capital (LPCAP). The fourth profit component captures the speed of adjustment process with the largest weights on BETAEQ and BETACAP. It varies inversely with the rate of adjustment.

In order to use both sets of profit variables, data from the Census of Manufactures and the Financial Statistics were linked.[6] The numbers-count equation for long-run entry was then estimated with the concentration components (PCR1 to PCR7) replacing the concentration variable (CON), the scale components (PS1 to PS3) replacing the scale variable (MES), and the profit components (PPROF1 to PPROF9) replacing the profit variables (PR). In keeping with the previous tests, both ordinary least squares and the negative binomial were employed.

The scale components by themselves had a negative effect on entry. When the scale components were included with the concentration components, they were always drowned out by the concentration components. This is not surprising. It was demonstrated in Baldwin and Gorecki (1991) that scale is an important determinant of concentration. When the various aspects of concentration are all entered with their components, there is little explanatory role that remains for scale. Therefore, the scale variables are omitted from the regression results reported here.

The results are presented in Table 9. The first column uses Census profit variables PR and GP for comparison to the previous

results. These estimates yield the same qualitative results as the more disaggregated data used in the previous sections. Profit is only significant at the 14% level. The concentration and scale barriers are highly significant in the negative binomial formulation.

The second set of estimates reported in column 2 replaces the Census profit variables--PR with average return on total capital (PRCAP7281). The significance of the profit variable remains about the same while the concentration and scale barrier variables remain significant. Thus, the definition of profitability does not significantly affect the results.

The remaining column report the results of adding various profit components that are related to the entry process. The coefficients associated with the three concentration components (PCON1, PCON2, PCON3) indicate that concentration has significant negative effects on entry. The first component, which places large negative weights on the four-firm and the herfindahl, has a positive coefficient in the entry regression. Thus, industries where the four-firm concentration ratio and the herfindahl are high have less entry. The other two concentration components have a negative effect on entry. The second component positively weights the share of the top four firms (CR4) and the share of the firms ranked five to eight (MCR8); the fifth component weights the herfindahl and the relative numbers ratio (RELNUM). Both the second and the fifth component emphasize the importance of the second largest tier of firms--but in different ways. A large presence by

this group serves to further limit entry.

While the profit variables used previously do not possess much significance, there are four components--PPROF2, PPROF3, PPROF4, PPROF8--that are related to entry. The two profit components that use the census margins--PPROF2,and PPROF8--and inversely weight small firm profitability have negative signs. The latter is significant; the former is not. Thus, higher small firm profitability has a positive effect on entry. The profitability component that varies directly with average book value and estimated long-run profitability (PPROF3) has a positive affect on entry. The component that varies inversely with the speed of adjustment (PPROF4) has a positive coefficient. Where profits return to equilibrium more quickly, there is less entry.

In summary, profitability does matter. But it is a combination of different dimensions that would appear to most closely affect entry. In particular, it is a combination of overall profitability and whether smaller firms can expect to earn these profits that matters most in stimulating entry.

6. CONCLUSIONS

This paper had investigated the robustness of the hypothesis that certain structural characteristics are barriers to entry. As often happens during robustness tests, we have learned not just whether a variable is important or whether a phenomenon exists, but instead the circumstances in which it matters.

When a more complex estimation procedure--regression for count data--was applied, the effect of entry barriers was more easily

separated from other variables. Extension of the model substantiated the importance of entry barriers but found that they impeded entry only for industries in which there was a relatively small number of firms. This exercise confirmed that barriers have a non-linear effect.

Barriers were found to have a different effect on the number of entrants than on the average size of entrants and thus on the market share that entrants capture. Structural barriers reduce the number of entrants but do not have a negative effect on the average size of the entrant. If anything, they tend to increase the size at which entry occurs.

Finally, it is not so much industry profitability that has a positive effect on entry. It is the rate of small firm profitability that attracts entrants. Greenfield entrants, we have seen, are generally small. Expectations of profitability are drawn from the experience of this small-firm population.

APPENDIX: Description of Variables

PR	The gross rate of return on capital defined as total activity value added less total activity value of wages and salaries, divided by the end of year gross capital stock for 1970.
GP	The ratio of the largest firm (top half of employment) weighted profit rate in 1979 to 1970, where profit rate is defined as the weighted margins/sales ratio.
GS	The growth rate for real total activity value of shipments between 1970 and 1979.
CON	4-firm concentration ratio index.
MES	The market share (in terms of shipments) of the smallest enterprise required to account for 50 percent of industry employment.
RD	The ratio of research and development personnel to all wage and salary earners.
AD	The advertising-sales ratio.
VMG	The volatility of market growth, defined as the standard error of the residuals taken from a regression of the logarithm of shipments on time.
N	The existing number of firms in an industry.
TVS	The value of total activity shipment of all firms in an industry
ASF	The average size of all firms in an industry measured in terms of shipment.
RELSIZE	The average size of entrants relative to the industry average size measured in terms of shipments.

REFERENCES

Bain, J.S. 1965. Barriers to New Competition. Cambridge, MA: Harvard University Press.

Baldwin, J.R. 1992. "Profitability and Firm Turnover", Unpublished paper. Ottawa: Statistics Canada, Business and Labour Market Analysis Group, Analytical Studies Branch.

Baldwin, J.R. and P.K. Gorecki. 1983. "Entry and Exit to the Canadian Manufacturing Sector: 1970-1979", Discussion Paper # 225. Ottawa: Economic Council of Canada.

Baldwin, J.R. and P.K. Gorecki. 1987. "Plant Creation Versus Plant Acquisition: The Entry Process in Canadian Manufacturing", International Journal of Industrial Organization 5: 27-41.

Baldwin, J.R. and P.K. Gorecki. 1990. "Measuring Firm Entry and Exit to the Canadian Manufacturing Sector: Methodology", in A.C. Singh and P. Whitridge (eds.) Analysis of Data in Time. Proceedings of a Conference Sponsored by Statistics Canada, Ottawa and Carleton Universities. Ottawa: Statistics Canada.

Baldwin, J.R. and P.K. Gorecki. 1991. "The Relationship Between Mobility and Concentration for the Canadian Manufacturing Sector", Discussion Paper # 23H. Ottawa: Statistics Canada, Business and Labour Market Analysis Group, Analytical Studies Branch.

Cable, J. and J. Schwalbach. 1991. "International Comparisons of Entry and Exit", in P.A. Geroski and J. Schwalbach (eds.) Entry and Market Contestability: An International Comparison. Oxford: Blackwell, 1991: 257-281.

Cameron, A.C. and P.K. Trivedi. 1986. "Econometric Models Based on Count Data: Comparisons and Applications of Some Estimators and Tests", Journal of Applied Econometrics 1: 29-54.

Chappell, W.F., M.S. Kimenyi and W.J. Mayer. 1990. "A Poisson Probability Model of Entry and Market Structure With an Application to U.S. Industries During 1972-77", Southern Economic Journal 56: 918-927.

Davies, S.W. 1980. "Minimum Efficient Size and Sellers Concentration: An Empirical Problem", Journal of Industrial Economics 28: 287-301.

Duetsch, L.L. 1984. "Entry and the Extent of Multiplant Operations", The Journal of Industrial Economics 32: 477-487.

Geroski, P.A. and R.T. Masson. 1987. "Dynamic Market Models in Industrial Organization",International Journal of Industrial

Organization 5: 1-13.

Geroski, P.K. and J. Schwalbach. 1991. Entry and Market Contestability: An International Comparison. Oxford: Blackwell.

Gourieroux, C., A. Monfort and A. Trognon. 1984. "Pseudo Maximum Likelihood Methods: Theory", Econometrica 52: 681-700.

Gourieroux, C., A. Monfort and A. Trognon. 1984. "Pseudo Maximum Likelihood Methods: Applications to Poisson Models", Econometrica 52: 701-720.

Hamilton, R.T. 1985. "Interindustry Variation in Gross Entry Rates of 'Independent' and 'Dependent Businesses", Applied Economics 17: 271-280.

Hause, J.C. and G. Du Rietz. 1984. "Entry, Industry Growth, and the Microdynamics of Industry Supply", Journal of Political Economy 92: 733-757.

Hausman, J., B.H. Hall and Z. Griliches. 1984. "Econometric Models for Count Data With an Application to the Patents-R&D Relationship", Econometrica 52: 909-938.

Kessides, I.N. 1986. "Advertising, Sunk Costs, and Barriers to Entry", Review of Economics and Statistics 68: 84-95.

Khemani, R.S. and D.M. Shapiro. 1986. "The Determinants of New Plant Entry in Canada", Applied Economics 18: 1243-1257.

Jeong, K.-Y and R.T. Masson. 1991. "Entry During Explosive Growth: Korea During Take-off", in P.A. Geroski and J. Schwalbach (ed.) Entry and Market Contestability: An International Comparison. Oxford: Blackwell, 1991: 143-167.

Macdonald, J.M. 1986. "Entry and Exit on the Competitive Fringe", Southern Economic Journal 52: 640-652.

Masson, R. and J. Shaanan. 1987. "Optimal Oligopoly Pricing and the Threat of Entry: Canadian Evidence", International Journal of Industrial Organization 5: 323-339.

Mayer, W.J. and W.F. Chappell. 1992. "Determinants of Entry and Exit: An Application of the Compounded Bivariate Poisson Distribution to U.S. Industries, 1972-1977", Southern Economic Journal 58(3): 770-778.

Modigliani, F. 1958. "New Developments on the Oligopoly Front", Journal of Political Economy 66: 215-232.

Mueller, D.C. 1986. Profits in the Long Run. Cambridge: Cambridge

University Press.

Orr, D. 1974. "The Determinants of Entry: A Study of the Manufacturing Industries", Review of Economics and Statistics 56(1): 58-66.

Papke, L.E. 1991. "Interstate Business Tax Differentials and New Firm Location: Evidence from Panel Data", Journal of Public Economics 45: 47-68.

Shapiro, D. and R.S. Khemani. 1987. "The Determinants of Entry and Exit Reconsidered", International Journal of Industrial Organization 5: 15-26.

NOTES

1. See Geroski and Schwalbach (1991) for a survey of the results of applying this model to different countries.

2. See Cable and Schwalbach 1991 for a survey of the Orr-type results.

3. The negative binomial was also used for the shipments variable and a logistic transformation of the relative size and the population success rate was also employed; in all cases, the same qualitative results were obtained.

4. Baldwin and Gorecki (1991a, b) define these variables.

5. See Baldwin (1992) for a definition of these variables.

6. See Baldwin (1992) for a discussion of the balance sheet rate of return definitions.

Table 1. COMPARISON OF ESTIMATION PROCEDURES FOR ENTRY MODEL

	LONG RUN			SHORT RUN		
	OLS	POISSON	NEGATIVE BINOMIAL	OLS	POISSON	NEGATIVE BINOMIAL
Constant	- 4.995 (0.500) [7.380]	3.587 (0.000) [0.087]	2.848 (0.000) [0.327]	- 73.218 (0.338) [76.190]	6.508 (0.000) [0.022]	6.005 (0.000) [0.359]
N	0.294 (0.000) [0.015]	0.003 (0.000) [0.000]	0.005 (0.000) [0.043]	2.482 (0.000) [0.066]	0.001 (0.000) [0.000]	0.003 (0.000) [0.0002]
PR	1.479 (0.598) [2.795]	0.121 (0.000) [0.025]	0.094 (0.520) [0.146]	9.946 (0.744) [30.390]	0.108 (0.000) [0.008]	0.145 (0.510) [0.221]
GP	0.166 (0.911) [1.480]	-0.045 (0.023) [0.020]	-0.062 (0.372) [0.070]	- 2.598 (0.872) [16.030]	- 0.054 (0.000) [0.005]	- 0.080 (0.263) [0.072]
GS	0.883 (0.046) [0.439]	0.083 (0.000) [0.006]	0.090 (0.000) [0.022]	14.653 (0.002) [4.675]	0.081 (0.000) [0.002]	0.089 (0.000) [0.019]
CON	- 0.074 (0.427) [0.093]	-0.023 (0.000) [0.001]	-0.018 (0.000) [0.004]	- 1.280 (0.196) [0.986]	- 0.027 (0.000) [0.000]	- 0.030 (0.000) [0.004]
MES	1.466 (0.952) [24.060]	-2.971 (0.000) [0.490]	-2.038 (0.033) [0.955]	- 77.137 (0.768) [260.718]	- 5.684 (0.000) [0.174]	- 2.158 (0.014) [0.876]
RD	0.00004 (0.999) [0.074]	0.006 (0.000) [0.001]	0.005 (0.362) [0.006]	1.191 (0.141) [0.806]	0.011 (0.000) [0.000]	0.013 (0.005) [0.005]
AD	-77.680 (0.311) [76.360]	-9.904 (0.000) [1.357]	-3.080 (0.399) [3.649]	-515.700 (0.533) [824.740]	- 6.297 (0.000) [0.335]	- 0.408 (0.902) [3.298]
VMG	0.084 (0.018) [0.035]	0.003 (0.000) [0.001]	0.004 (0.012) [0.002]	1.247 (0.001) [0.382]	0.003 (0.000) [0.000]	0.003 (0.046) [0.002]
Variance Parameter α			0.372 (0.000) [0.043]			0.487 (0.000) [0.057]
Adj R^2	0.81			0.93		
- Log L		1016.099	591.998		8711.917	997.528

Table 2. DESCRIPTIVE STATISTICS FOR ENTRY COUNTS, PREDICTED ENTRY, AND RESIDUALS

	OLS				NEGATIVE BINOMIAL			
	Mean	Sd[1]	Min[2]	Max[3]	Mean	Sd	Min	Max
Observed Entry (E)	16.03	17.31	0.00	71.00	16.03	17.31	0.00	71.00
Predicted entry (E^)	16.03	15.80	-3.98	65.93	17.19	21.47	2.52	109.9
Residuals	0.00	7.07	-27.93	19.96	-1.16	10.66	-51.86	24.37

1. Sd = Standard deviation
2. Min = Minimum value
3. Max = Maximum value

Table 3. OBSERVED AND PREDICTED ENTRY COUNTS

		OLS			NEGATIVE BINOMIAL		
Observed entry counts E	Mean observed entry E'	Mean predicted entry E^	Minimum predicted entry $E^{\wedge}_{min}$	Maximum predicted entry $E^{\wedge}_{max}$	Mean predicted entry E^	Minimum predicted entry $E^{\wedge}_{min}$	Maximum predicted entry $E^{\wedge}_{max}$
0-5	2.26	3.26	-3.98	11.80	4.98	2.52	12.46
5-10	6.58	7.90	0.44	19.16	7.74	3.12	18.17
10-15	12.00	13.94	6.48	39.93	11.15	5.62	35.33
15-20	16.10	18.61	12.84	27.41	13.78	8.07	21.99
20-25	22.29	18.19	11.97	22.32	13.82	7.98	21.20
25-30	27.50	32.00	21.64	52.71	30.87	17.49	65.85
30-35	32.25	36.75	20.38	48.81	38.58	15.57	60.45
35-40	37.71	31.24	23.29	47.20	30.20	17.17	60.58
40+	55.87	48.16	29.35	65.93	64.05	22.58	109.90

Table 4. COMPARISON OF DIFFERENT ENTRY MODELS : NEGATIVE BINOMIAL ESTIMATES

	(1)	(2)	(3)	(4)	(5)	(6)
Constant	4.561 (0.000) [0.292]	2.848 (0.000) [0.327]	2.498 (0.000) [0.257]	7.944 (0.000) [0.284]	6.005 (0.000) [0.359]	5.409 (0.000) [0.303]
PR	0.083 (0.534) [0.133]	0.094 (0.520) [0.146]	0.064 (0.626) [0.131]	0.031 (0.846) [0.160]	0.145 (0.510) [0.221]	0.162 (0.389) [0.188]
GP	-0.107 (0.195) [0.083]	-0.062 (0.372) [0.070]	-0.071 (0.256) [0.062]	-0.103 (0.220) [0.084]	-0.080 (0.263) [0.072]	-0.073 (0.257) [0.065]
GS	0.131 (0.000) [0.025]	0.090 (0.000) [0.022]	0.056 (0.001) [0.017]	0.108 (0.000) [0.022]	0.089 (0.000) [0.192]	0.052 (0.002) [0.016]
CON	-0.036 (0.000) [0.004]	-0.018 (0.000) [0.004]	-0.014 (0.002) [0.005]	-0.049 (0.000) [0.004]	-0.030 (0.000) [0.004]	-0.025 (0.000) [0.004]
MES	- 2.585 (0.032) [1.210]	-2.038 (0.033) [0.955]	-6.935 (0.000) [1.414]	-2.160 (0.039) [1.047]	-2.158 (0.014) [0.876]	-5.642 (0.000) [1.082]
RD	0.009 (0.185) [0.006]	0.005 (0.362) [0.006]	0.005 (0.411) [0.006]	0.016 (0.001) [0.005]	0.013 (0.005) [0.005]	0.005 (0.147) [0.004]
AD	- 6.206 (0.116) [3.952]	-3.080 (0.400) [3.649]	0.356 (0.941) [4.839]	-4.552 (0.231) [3.803]	-0.408 (0.902) [3.298]	-0.696 (0.882) [4.695]
VMG	0.002 (0.370) [0.002]	0.004 (0.012) [0.002]	0.004 (0.002) [0.001]	-0.001 (0.471) [0.002]	0.003 (0.046) [0.001]	0.004 (0.005) [0.001]
N		0.005 (0.000) [0.001]	0.004 (0.000) [0.001]		0.003 (0.000) [0.0002]	0.002 (0.002) [0.0005]
CON X N			0.00003 (0.487) [0.00005]			0.00002 (0.368) [0.00002]
AD X N			-0.076 (0.064) [0.041]			-0.015 (0.636) [0.031]
RD X N			-0.0007 (0.313) [0.0007]			0.000003 (0.967) [0.00008]
MES X N			0.231 (0.000) [0.042]			0.144 (0.000) [0.024]
Variance Parameter α	0.565 (0.000) [0.065]	0.372 (0.000) [0.043]	0.201 (0.000) [0.026]	0.713 (0.000) [0.086]	0.487 (0.000) [0.057]	0.311 (0.000) [0.039]
- Log L	620.304	591.998	556.235	1033.470	997.528	958.751

Table 5 COMPARISON OF DIFFERENT ENTRY MEASURES : LONG RUN

	E[a]	TVSE	ASE	RATIO
Constant	2.923 (0.000) [0.280]	19.207 (0.000) [4.529]	8.837 (0.132) [5.828]	0.051 (0.060) [0.027]
PR	0.125 (0.411) [0.152]	- 0.863 (0.680) [2.090]	- 2.514 (0.351) [2.686]	-0.010 (0.383) [0.012]
GP	-0.033 (0.602) [0.063]	- 2.348 (0.043) [1.152]	- 2.854 (0.057) [1.487]	-0.008 (0.246) [0.007]
GS	0.082 (0.000) [0.018]	1.024 (0.002) [0.327]	0.621 (0.138) [0.417]	0.003 (0.153) [0.002]
CON	- 0.018 (0.000) [0.004]	- 0.015 (0.015) [0.062]	0.095 (0.249) [0.082]	0.002 (0.000) [0.000]
MES	- 1.806 (0.038) [0.872]	-27.703 (0.127) [18.060]	-45.760 (0.051) [23.204]	-0.086 (0.406) [0.103]
RD	0.004 (0.377) [0.005]	0.094 (0.095) [0.056]	0.168 (0.020) [0.071]	-0.001 (0.032) [0.000]
AD	- 3.103 (0.312) [3.069]	-78.861 (0.166) [56.700]	-55.002 (0.450) [72.518]	-0.308 (0.335) [0.318]
VMG	0.003 (0.012) [0.001]	0.006 (0.828) [0.027]	0.007 (0.984) [0.034]	0.0003 (0.096) [0.000]
N	0.005 (0.000) [0.0004]			
TVS		0.000004 (0.000) [0.000]		
ASF			0.0001 (0.001) [0.000]	
RELSIZE				-0.00002 (0.195) [0.000]
Adj R^2		0.41	0.32	0.25
F		13.35	9.32	6.92
Degress of freedom		(9,148)	(9,148)	(9,148)

a Excludes all zero values of the dependent variable

Table 6

COMPARISON OF DIFFERENT ENTRY MEASURES : SHORT RUN

	E	TVSE	ASE
Constant	6.005 (0.000) [0.359]	44.698 (0.000) [10.150]	3.818 (0.132) [2.521]
PR	0.145 (0.510) [0.221]	-0.266 (0.954) [4.661]	-1.078 (0.358) [1.169]
GP	-0.084 (0.263) [0.072]	-3.687 (0.135) [2.456]	-1.439 (0.021) [0.618]
GS	0.089 (0.000) [0.019]	2.461 (0.001) [0.719]	0.305 (0.090) [0.179]
CON	-0.030 (0.000) [0.004]	-0.459 (0.001) [0.014]	0.039 (0.278) [0.036]
MES	-2.158 (0.014) [0.876]	-69.727 (0.084) [40.150]	-22.089 (0.030) [10.063]
RD	0.013 (0.005) [0.005]	0.168 (0.183) [0.126]	0.070 (0.026) [0.031]
AD	-0.408 (0.902) [3.298]	-256.150 (0.045) [126.976]	-47.916 (0.132) [31.675]
VMG	0.003 (0.046) [0.002]	0.036 (0.537) [0.059]	0.004 (0.797) [0.015]
N	0.0003 (0.000) [0.0002]		
TVS		0.003 (0.000) [0.0003]	
ASF			0.151 (0.000) [0.015]
Adj R^2		0.52	0.45
F		20.98	15.70
Degrees of Freedom		(9,156)	(9,156)

Table 7. PRINCIPAL-COMPONENT ANALYSIS PERFORMED ON CONCENTRATION VARIABLES

	EIGENVECTORS						
	PCR1	PCR2	PCR3	PCR4	PCR5	PCR6	PCR7
CR4	-0.4304	0.4171	0.0307	-0.1200	-0.1697	0.6607	0.4001
HF	-0.4451	0.3158	-0.1259	-0.0562	0.6124	-0.4920	0.2570
MCR8	0.1521	0.4644	0.7794	-0.2081	-0.1779	-0.2723	-0.0683
REL84	0.4565	-0.0292	0.3042	0.2705	0.6542	0.3873	0.2172
RELNUM	0.1917	0.6723	-0.3570	0.2902	0.0560	0.1073	-0.5337
VARS	-0.3710	-0.0809	0.2770	0.8597	-0.1744	-0.0976	0.0091
RELRED	0.4591	0.2264	-0.2811	0.2066	-0.3210	-0.2760	0.6611
Proportion of total sample variability accounted for	0.5426	0.2201	0.1291	0.0758	0.0267	0.0041	0.0016

Table 8. PRINCIPAL-COMPONENT ANALYSIS PERFORMED ON PROFITABILITY VARIABLES

	EIGENVECTORS								
	PPROF1	PPROF2	PPROF3	PPROF4	PPROF5	PPROF6	PPROF7	PPROF8	PPROF9
PREQ7281	0.3503	0.2270	0.4052	-0.3495	-0.1768	-0.5856	-0.0172	0.3574	-0.1929
PRCAP7281	0.4267	0.1884	0.4077	-0.1787	-0.0776	0.5197	-0.3046	-0.4459	-0.1287
LPCAP	-0.1449	0.3639	0.5005	0.3537	-0.1234	0.0595	0.2489	0.0727	0.6204
LPEQ	0.4756	-0.1157	-0.1296	0.4962	0.1618	-0.0701	-0.5660	0.3005	0.2319
BETACAP	0.4046	-0.2378	-0.2533	-0.5151	-0.0249	0.1082	0.2501	0.0448	0.6100
BETAEQ	0.5169	-0.0544	-0.0952	0.4437	-0.0768	-0.1251	0.6070	-0.2727	-0.2391
PR	0.0168	-0.5147	-0.4246	0.0291	0.1912	0.4005	0.2368	0.5072	-0.2082
PRSMALL	-0.0875	-0.5113	0.3836	-0.0078	0.3272	-0.4364	-0.1039	-0.4927	0.1808
GP	0.0854	0.4258	-0.0391	-0.1071	0.8782	0.0169	0.1564	0.0380	-0.0314
Proportion of total sample variability accounted for	0.2876	0.2324	0.2152	0.1268	0.0840	0.0264	0.0128	0.0089	0.0060

Table 9. COMPARISON OF DIFFERENT PROFITABILITY MEASURES: NEGATIVE BINOMIAL ESTIMATES[1,2]

	(1)	(2)	(3)
Constant	5.857 (0.000) [0.157]	5.682 (0.000) [0.197]	5.233 (0.000) [0.058]
N	0.0002 (0.000) [0.00002]	0.0002 (0.000) [0.00002]	0.0001 (0.000) [0.0002]
PR	0.157 (0.140) [0.107]		
GP	-0.002 (0.938) [0.030]	-0.087 (0.005) [0.031]	
GS	4.868 (0.000) [1.013]	5.241 (0.000) [1.127]	5.178 (0.000) [1.045]
CON	-1.612 (0.000) [0.236]	-1.201 (0.000) [0.239)	
MES	1.447 (0.070) [0.799]	1.049 (0.197) [0.814]	
RD	325.220 (0.127) [212.800]	307.400 (0.195) [237.000]	249.600 (0.313) [247.400]
AD	0.596 (0.000) [0.067]	0.753 (0.000) [0.074]	0.601 (0.000) [0.057]
VMG	-0.020 (0.983) [0.890]	-0.693 (0.440) [0.898]	
PRCAP7281		1.415 (0.171) [1.035]	
PCON1			0.167 (0.000) [0.152]
PCON2			-0.519 (0.000) [0.037]
PCON3			-0.156 (0.004) [0.054]
PPROF2			-0.026 (0.288) [0.025]
PPROF3			0.044 (0.068) [0.024]
PPROF4			0.085 (0.000) [0.021]
PPROF8			-0.176 (0.034) [0.083]
Variance Parameter α	0.102 (0.000) [0.004]	0.112 (0.000) [0.004]	0.078 (0.000) [0.003]
-Log L	716.360	712.447	699.405

1. The significance levels of a two-tailed test for rejecting the null hypothesis that the coefficients are zero are given in parentheses.
2. The associated standard errors of the estimates are reported in brackets.

ANALYTICAL STUDIES BRANCH
RESEARCH PAPER SERIES

No.

1. *Behavioural Response in the Context of Socio-Economic Microanalytic Simulation,* ***Lars Osberg***

2. *Unemployment and Training,* ***Garnett Picot***

3. *Homemaker Pensions and Lifetime Redistribution,* ***Michael Wolfson***

4. *Modelling the Lifetime Employment Patterns of Canadians,* ***Garnett Picot***

5. *Job Loss and Labour Market Adjustment in the Canadian Economy,* ***Garnett Picot and Ted Wannell***

6. *A System of Health Statistics: Toward a New Conceptual Framework for Integrating Health Data,* ***Michael C. Wolfson***

7. *A Prototype Micro-Macro Link for the Canadian Household Sector,* ***Hans J. Adler and Michael C. Wolfson***

8. *Notes on Corporate Concentration and Canada's Income Tax,* ***Michael C. Wolfson***

9. *The Expanding Middle: Some Canadian Evidence on the Deskilling Debate,* ***John Myles***

10. *The Rise of the Conglomerate Economy,* ***Jorge Niosi***

11. *Energy Analysis of canadian External Trade: 1971 and 1976,* ***K.E. Hamilton***

12. *Net and Gross Rates of Land Concentration,* ***Ray D. Bollman and Philip Ehrensaft***

13. *Cause-Deleted Life Tables for Canada (1972 to 1981): An Approach Towards Analyzing Epidemiologic Transition,* ***Dhruva Nagnur and Michael Nagrodski***

14. *The Distribution of the Frequency of Occurence of Nucleotide Subsequences, Based on Their Overlap Capability,* ***Jane F. Gentleman and Ronald C. Mullin***

15. *Immigration and the Ethnolinguistic Character of Canada and Quebec,* ***Réjean Lachapelle***

16. *Integration of Canadian Farm and Off-Farm Markets and the Off-Farm Work of Women, Men and Children,* ***Ray D. Bollman and Pamela Smith***

17. *Wages and Jobs in the 1980s: Changing Youth Wages and the Declining Middle,* ***J. Myles, G. Picot and T. Wannell***

18. *A Profile of Farmers with Computers,* ***Ray D. Bollman***

19. *Mortality Risk Distributions: A Life Table Analysis,* ***Geoff Rowe***

20. *Industrial Classification in the Canadian Census of Manufactures: Automated Verification Using Product Data,* ***John S. Crysdale***

21. *Consumption, Income and Retirement,* ***A.L. Robb and J.B. Burbridge***

22. *Job Turnover in Canada's Manufacturing Sector,* ***John R. Baldwin and Paul K. Gorecki***

23. *Series on The Dynamics of the Competitive Process,* ***John R. Baldwin and Paul K. Gorecki***

    A. *Firm Entry and Exit Within the Canadian Manufacturing Sector.*
    B. *Intra-Industry Mobility in the Canadian Manufacturing Sector.*
    C. *Measuring Entry and Exit in Canadian Manufacturing: Methodology.*
    D. *The Contribution of the Competitive Process to Productivity Growth: The Role of Firm and Plant Turnover.*
    E. *Mergers and the Competitive Process.*
    F. *(in preparation)*
    G. *Concentration Statistics as Predictors of the Intensity of Competition.*
    H. *The Relationship Between Mobility and Concentration for the Canadian Manufacturing Sector.*

24. *Mainframe SAS Enhancements in Support of Exploratory Data Analysis,* ***Richard Johnson and Jane F. Gentleman***

25. *Dimensions of Labour Market Change in Canada: Intersectoral Shifts, Job and Worker Turnover,* ***John R. Baldwin and Paul K. Gorecki***

26. *The Persistent Gap: Exploring the Earnings Differential Between Recent Male and Female Postsecondary Graduates,* ***Ted Wannell***

27. *Estimating Agricultural Soil Erosion Losses From Census of Agriculture Crop Coverage Data,* ***Douglas F. Trant***

28. *Good Jobs/Bad Jobs and the Declining Middle: 1967-1986,* ***Garnett Picot, John Myles, Ted Wannell***

29. *Longitudinal Career Data for Selected Cohorts of Men and Women in the Public Service, 1978-1987,* ***Garnett Picot and Ted Wannell***

30. *Earnings and Death - Effects Over a Quarter Century*, ***Michael Wolfson, Geoff Rowe, Jane F. Gentleman adn Monica Tomiak***

31. *Firm Response to Price Uncertainty: Tripartite Stabilization and the Western Canadian Cattle Industry*, ***Theodore M. Horbulyk***

32. *Smoothing Procedures for Simulated Longitudinal Microdata*, ***Jane F. Gentleman, Dale Robertson and Monica Tomiak***

33. *Patterns of Canadian Foreign Direct Investment Abroad*, ***Paul K. Gorecki***

34. *POHEM - A New Approach to the Estimation of Health Status Adjusted Life Expectancy*, ***Michael C. Wolfson***

35. *Canadian Jobs and Firm Size: Do Smaller Firms Pay Less?*, ***René Morissette***

36. *Distinguishing Characteristics of Foreign High Technology Acquisitions in Canada's Manufacturing Sector*, ***John R. Baldwin and Paul K. Gorecki***

37. *Industry Efficiency and Plant Turnover in the Canadian Manufacturing Sector*, ***John R. Baldwin***

38. *When the Baby Boom Grows Old: Impacts on Canada's Public Sector*, ***Brian B. Murphy and Michael C. Wolfson***

39. *Trends in the distribution of Employment by Employer Size: Recent Canadian Evidence*, ***Ted Wannell***

40. *Small Communities in Atlantic Canada: Their Industrial Structure and Labour Market conditions in the Early 1980s*, ***Garnett Picot and John Heath***

41. *The Distribution of Federal/Provincial Taxes and Transfers in rural Canada*, ***Brian B. Murphy***

42. *Foreign Multinational Enterprises and Merger Activity in Canada*, ***John Baldwin and Richard Caves***

43. *Repeat Users of the Unemployment Insurance Program*, ***Miles Corak***

44. *POHEM -- A Framework for Understanding and Modelling the Health of Human Population*, ***Michael C. Wolfson***

45. *A Review of Models of Population Health Expectancy: A Micro-Simulation Perspective*, ***Michael C. Wolfson and Kenneth G. Manton***

46. *Career Earnings and Death: A Longitudinal Analysis of Older Canadian Men,* ***Michael C. Wolfson, Geoff Rowe, Jane Gentleman and Monica Tomiak***

47. *Longitudinal Patterns in the Duration of Unemployment Insurance Claims in Canada,* ***Miles Corak***

48. *The Dynamics of Firm Turnover and the Competitive Process,* ***John Baldwin***

49. *Development of Longitudinal Panel Data from Business Registers: Canadian Experience,* ***John Baldwin, Richard Dupuy and William Penner***

50. *The Calculation of Health-Adjusted Life Expectancy for a Multi-Attribute Utility Function: A First Attempt,* ***J.-M. Berthelot, R. Roberge and M.C. Wolfson***

51. *Testing The Robustness of Entry Barriers,* ***J. R. Baldwin, M. Rafiquzzaman***

52. *Canada's Multinationals: Their Characteristics and Determinants,* ***Paul K. Gorecki***

For further information, contact the Chairperson, Publications Review Committee, Analytical Studies Branch, R.H. Coats Bldg., 24th Floor, Statistics Canada, Tunney's Pasture, Ottawa, Ontario, K1A 0T6, (613) 951-8213.